REMARKS

In the last Office Action, claims 1-4, 7, 8, 10, 13-17 and 21 were rejected under 35 U.S.C. §103(a) as unpatentable over Miyazawa (USPN 5,247,220) or the prior art disclosure (PAD) in view of Sumihara (USPN 5,448,129). Claims 5, 6 and 18-20 were rejected under 35 U.S.C. §103(a) as unpatentable over Miyazawa or PAD in view of Sumihara and further in view of Sawayama (USPN 4,926,805). Claim 12 was allowed.

Applicants and applicants' attorney acknowledge with appreciation the allowance of claim 12. For the reasons discussed below, applicants respectfully submit that independent claims 1 and 13 as amended herein, and their dependent claims also patentably distinguish over the prior art.

The present invention pertains to an apparatus having a power supply for supplying power to an electrical device and a movable member driven by an ultrasonic motor, the ultrasonic motor having a piezoelectric element driven by a driving circuit to undergo vibration to drive an oscillating member in contact with the piezoelectric element, the piezoelectric element and the driving circuit forming a self-oscillation circuit.

As pointed out by applicants at pages 1-2 of the specification, a wide variety of electronic devices are commonly equipped with an ultrasonic motor for use as a source of motive power. An illustration of a known analog clock having such a construction is shown in Fig. 11 of the application drawings. An oscillating body 3 having a piezoelectric device 4 bonded thereto generates an oscillatory wave by self-excited oscillation to drive a moving body 5. A base plate 21 is directly connected to the positive terminal of a power supply for driving the clock and serves as a lead wire for carrying a positive potential to the clock movement. When an ultrasonic motor is mounted to the base plate 21, electrodes of the piezoelectric device 4 short-circuit with the positive power supply terminal through the base plate 21 and stable driving becomes impossible. As a result, in order to mount a self-oscillation circuit (self-oscillating drive circuit) for an ultrasonic motor, it is necessary to form the base plate of an insulating material or to provide a separate insulator between the base plate and the ultrasonic motor.

This is because the various components of the ultrasonic motor, including the oscillating member, the moving body, the output member, and a pressing mechanism, are typically formed of conductive materials. When a voltage is applied to the base plate 21, a current path can easily be established between at least one of the electrodes of the

piezoelectric element and at least one of the power supply terminals. This makes stable driving of the motor impossible. Since various components of the ultrasonic motor are formed of conductive materials, it becomes necessary to eliminate the current path between the power supply and the piezoelectric device by forming components of the electronic device contacting the ultrasonic motor of a non-conductive insulating material. However, this imposes restrictions on the electronic device structure in which the ultrasonic motor is mounted. In a small electronic device, it is difficult to provide an insulating structure due to space restrictions and, if an insulating structure is mounted therein, it may be difficult or impossible to also mount an ultrasonic motor.

The present invention solves this problem in a simple yet effective manner and does so without imposing size or structural restrictions on the electronic device. In accordance with the invention, an ultrasonic motor is driven by a self-oscillation circuit, which is advantageous due to its small size and excellent frequency follow-up characteristics, and one or more components of the ultrasonic motor are made of insulating material or have insulating surfaces to prevent a current path from being established between the conductive plate member (which is connected to the power supply) and electrodes of the piezoelectric element of the ultrasonic motor. More particularly, one or more of the

oscillating member, moving body and pressing mechanism of the ultrasonic motor are formed of an insulating material or formed with an insulating surface so that no additional insulating structure is needed to prevent a current path from existing between the conductive base plate and the piezoelectric element electrodes. As a consequence, it is possible to realize an ultrasonic motor that does not impose structural restrictions on the electronic device in which it is mounted.

Independent claims 1 and 13, as amended, recite an apparatus having a power supply for supplying power to an electrical device and a movable member driven by an ultrasonic motor, wherein the ultrasonic motor is mounted to a conductive member (base plate) through which a power supply current is passed from the power supply to the electrical device. Claims 1 and 13 further recite that the ultrasonic motor comprises a piezoelectric element, a driving circuit cooperating with the piezoelectric element to form a self-oscillation circuit for driving the piezoelectric element, an oscillating member in contact with the piezoelectric element to undergo oscillation in response to vibration of the piezoelectric element, a moving body disposed on the oscillating member to undergo movement in response to oscillation of the oscillating member, and a pressing mechanism for urging the moving body against the oscillating member. Claims 1 and 13 further recite that

the ultrasonic motor is constructed such that if the oscillating member, the pressing mechanism and the moving body were formed of conductive materials, a current path would be established between the conductive member on which the ultrasonic motor is mounted and an electrode of the piezoelectric element, and that at least one of the oscillating member, the pressing mechanism and the moving body is formed of an insulating material having a volume resistivity sufficient to prevent establishment of the current path and attain stable self-oscillation without the need for additional insulator between the conductive member and the ultrasonic motor. No similar apparatus is disclosed or suggested by the prior art references.

The primary reference to Miyazawa discloses in Fig. 44 an ultrasonic motor which, as noted by the Examiner, comprises an oscillating member 2-27, a conductive support member 4-27, a piezoelectric element 3-27, a moving body 1-27 and a pressing mechanism 9-27. The piezoelectric element 3-27 has on its underside electrodes 3a-27 which are electrically connected through an anisotropic conductor 46 to a circuit pattern 47a on an insulating substrate 47 disposed on the conductive support member 4-27. The anisotropic conductor 46 is comprised of rod-shaped conductors 46a separated by insulators 46b, and the rod-shaped conductors 46b provide a current path between the piezoelectric element electrodes

3a-27 and the circuit pattern 47a on the substrate 47. This exemplifies the prior art constructions in which a separate insulating structure in the form of the insulating substrate 47 is required rather than, as in the case of the present invention, forming one or more of the oscillating member, moving body or pressing mechanism of an insulating material or with an insulating surface so that no additional insulator is needed to prevent a current path existing between the conductive support member and the electrode(s) of the piezoelectric element. More importantly, Miyazawa does not disclose forming at least one of the oscillating member 2-27, moving body 1-27 and pressing mechanism 9-27 of insulating material or with an insulating surface as required by independent claims 1 and 13.

As acknowledged by the Examiner, both Miyazawa and PAD (shown in Fig. 11 and described in the present specification) require additional insulation between the ultrasonic motor and the conductive member on which the ultrasonic motor is mounted. Neither Miyazawa nor PAD teach or suggest that the insulation between the conductive member and the ultrasonic motor can be eliminated without short-circuiting the electrodes of the piezoelectric device through the conductive member, which would result in unstable self-oscillation or complete stoppage of the ultrasonic motor. Thus insofar as pertinent to independent claims 1 and 13, both

Miyazawa and PAD teach that insulation between the ultrasonic motor and the conductive member on which the motor is mounted is required in order to obtain stable self-oscillation.

In the statement of rejection, the Examiner states that it would have been obvious to one of ordinary skill in the art to modify Miyazawa or PAD to construct the moving bodies thereof of fiber-reinforced resin as taught by Sumihara to obtain the benefits of lighter weight, ease of manufacture, etc. described by Sumihara. Applicants respectfully point out, however, that even if such a modification were made, both Miyazawa and PAD would still retain insulation between the ultrasonic motor and the conductive member on which the motor is mounted. Stated otherwise, even if Miyazawa and PAD were modified in the manner proposed in the statement of rejection, the modified devices would still have additional insulation between the ultrasonic motor and the conductive member and hence would not meet the terms of claims 1 and 13.

Sumihara certainly does not contain any teaching of eliminating an insulator between an ultrasonic motor and a conductive member on which the motor is mounted by forming the moving body of a fiber-reinforced resin. Therefore Sumihara would not have taught or suggested to one skilled in the art to eliminate the insulators employed in Miyazawa and PAD. Instead, Sumihara simply teaches the benefits of forming the moving body of a fiber-reinforced resin, and such benefits

would still exist if the moving bodies of Miyazawa and PAD were formed of fiber-reinforced; however, the Miyazawa and PAD devices would still have an insulator between the conductive member and the ultrasonic motor.

Therefore even if Miyazawa and PAD were modified in view of Sumihara in the manner proposed in the statement of rejection, the modified devices would not correspond to that recited in claims 1 and 13. The claims require preventing "establishment of the current path without the need for an additional insulator between the conductive member and the ultrasonic motor," and the modified devices which still have an additional insulator between the conductive member and the ultrasonic motor.

Moreover, claims 1 and 13 require that at least one of the oscillating member, the pressing mechanism and the moving body be formed of an insulating material having a volume resistivity sufficient to prevent establishment of the current path and attain stable self-oscillation without the need for an additional insulator between the conductive member and the ultrasonic motor. It is not seen where the various composites disclose by Sumihara have sufficient volume resistivity to prevent establishment of a current path and attain stable self-oscillation if the insulator between the conductive member and the ultrasonic motor were eliminated in the Miyazawa and PAD devices. If the moving bodies of

Miyazawa and PAD were formed of carbon fiber reinforced resin, such resin material would affect self-oscillation of the self-oscillation circuit and stable self-oscillation would not be attained.

In view of the foregoing, applicants respectfully submit that the combined teachings of the prior art do not suggest or render obvious the subject matter of independent claims 1 and 13 and the claims dependent thereon. Accordingly, favorable reconsideration and passage of the application to issue are respectfully requested.

Respectfully submitted,

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